

2. On the Marine Fauna of Zanzibar and British East Africa, from Collections made by Cyril Crossland in the Years 1901 and 1902.—Polychæta. Part I. By CYRIL CROSSLAND, B.A., B.Sc.¹

[Received January 15, 1903.]

(Plates XVI. & XVII.²)

Introduction.

The collections referred to were made under the following circumstances:—Sir Charles Eliot, K.C.M.G., C.B., late Fellow of All Souls College, Oxford, at present H.M. Consul-General at Zanzibar and Commissioner for British East Africa, took me out with him as his private assistant in his researches on Nudibranch Mollusca. I made collections not only of this, but of the other marine groups; accounts of which, by various specialists, will appear in these 'Proceedings' from time to time. The largest collections are those of the Nudibranchiate Mollusca and Polychæte Annelids, of which groups about 150 species in each are to be described. Sir Charles Eliot has already published one part of the results of his examination of the Nudibranchs (P. Z. S. 1902, vol. ii. p. 62); other papers by various authors will shortly be ready.

For the benefit of other possible workers in this region, I may mention that the greater part of my collections was made in two localities, viz. Chuaka Bay, on the east coast of Zanzibar, and Wasin Harbour, near the Anglo-German boundary on the mainland. The former locality is extremely rich in shore forms, and dredging in 3 fathoms of water at the north side of the mouth of the bay was often very productive. Wasin Harbour averages a depth of 10 fathoms, and here I collected almost entirely by dredging. The bottom is extensively covered by a species of *Telestoa*, the branches of which are overgrown by an encrusting red sponge. Among this a great variety of the smaller Polychæta and Nudibranchiata are found.

My mention of these two localities is of the more importance to future workers because large stretches of the coast are extremely barren. Unfortunately this applies to the two principal towns of East Africa, and especially to Mombasa. A few miles from Zanzibar, *e. g.* round the islands and sandbanks which surround the harbour, and on one portion of the shore about a mile to the south of the town, *at low spring-tide only*, are rich collecting-grounds, and near this latter area dredging is profitable, especially at a depth of 5 fathoms. The greatest portion of the Zanzibar channel is, however, extremely barren.

More detailed descriptions of the reefs of East Africa, with maps, will be found in my two papers: "On the Coral Reefs of Zanzibar," and "Pemba and British East Africa," in the Proc. Camb. Phil. Soc. vols. xi. & xii. (1902).

¹ Communicated by Prof. W. C. McINTOSH, F.Z.S.

² For explanation of the Plates, see p. 176.

The gratitude of all zoologists is thus due to Sir Charles Eliot, whose generosity and scientific zeal have enabled these collections, the first of considerable size from this region, to be made. I wish also to express my best thanks to Mr. Stanley Gardiner, who helped me by his advice and in every other possible way, both during my residence in East Africa and in the working out of the collections on my return to England.

CHÆTOPTERIDÆ.

Genus PHYLLOCHÆTOPTERUS.

The position of the genus *Phyllochætopterus* among the lower Chætopteridæ is shown by the following table of the genera:—

A. Notopodia of the second body-region not foliaceous (i. e. two body-regions only)	RANZANIA.
B. With foliaceous notopodia posteriorly.	
1. Body divided into two regions	TELEPSAVUS.
2. Body divided into three regions.	
{ One pair of tentacles	SPIOCHÆTOPTERUS.
{ Two pairs of tentacles	PHYLLOCHÆTOPTERUS.

The most characteristic feature of the Chætopteridæ is the adaptation of certain parapodia for the production of a respiratory current, which modification, completed in the genus *Chætopterus*, makes the latter one of the most remarkable forms of animal life.

This peculiarity is not developed in *Ranzania*, whose only Chætopterid features are its general build of body, which is divided into an anterior flattened muscular and glandular portion bearing long notopodial setæ only, and a rounder weaker posterior portion with delicate notopodia and neuropodia of uncinigeral tori; in addition it is tubicolous in its mode of life, and procures food by the ciliated grooves of its tentacles and dorsal surface.

To these features are added notopodial gills in *Telepsavus*, in which case they are developed on every segment of the hind-body. In the remaining two genera this modification is restricted to more or fewer of the middle segments, to two only in *Spiochætopterus* and several species of *Phyllochætopterus*, but up to 25 in other species of the latter.

In all the eight species of *Phyllochætopterus* yet known the body is vermiform, the notopodial gills comparatively small and simple, bifid, and containing capillary setæ. All the setæ are characteristically Chætopterid, in the first region long with leaf-like ends, and arranged in a row as in *Chætopterus*, though the notopodia of *P. aciculigerus* alone approach in their long pointed shape those of the former genus. In the fourth notopodium of the first body-region one or more setæ are enlarged and of a dark brown colour, but are not flattened as in *Chætopterus*. The uncini are of one kind only throughout the body, but their form is more specialized than in *Chætopterus*, and is that which occurs in, for example, the Sabellidæ. The parapodia are alike in all the species, differing only in the proportions of the parts, excepting the hind-body notopodia of *P. aciculigerus* (6).

The prostomium is, in this family, usually more or less reduced. In *Chaetopterus* itself it is completely merged with the oral funnel, and the same condition is described for some Phyllochaetopterids (e. g. *P. claparedi* McIntosh). In all the members of this genus it is normally scarcely distinguishable externally, both pairs of tentacles being carried by the peristomium. In certain specimens of *P. elioti*, however, as described below, it is quite prominent, and so was discoverable in all the four species I have examined.

The first body-region is an almost solid mass of muscular and glandular tissue in all species, but posteriorly musculature is confined to the ventral surface, except at the level of the parapodia, where muscle-bands surround the body. Between these the body-wall is excessively thin dorsally and laterally, and always black from the colour of the gut-walls.

Up to the present six species have been described, viz. :—

- P. socialis* Claparède. Mediterranean and Atlantic (1) (4).
- P. major* Claparède. Mediterranean (1).
- P. gracilis* Langerhans. Canary Islands (2).
- P. claparedi* McIntosh. Japan (3).
- P. aciculigerus* Crossland. The Maldive Islands (6).
- P. gardineri* Crossland. The Maldive Islands (6).

To these I now add :—

- P. elioti*. Zanzibar.
- P. pictus*. British East Africa.

Claparède's *P. fallax* was founded on such characters as the numbers of segments composing the three body-regions, the ringing of the tube, &c.; these have been shown by Roule (4) to be variable in members of this genus.

The principal distinctions of systematic importance are :—

- (1) Presence or absence of eye-spots, and of the development of the prostomium.
- (2) The number of the strong setæ in the notopodium of the fourth setigerous segment.
- (3) The proportionate sizes of the parts of the parapodia of the regions B and C.
- (4) Ringing and other such details of the tubes are variable, but (1) in some species they are straight and occur singly, and (2) in others they are of a U-shape and occur in numbers twisted together.

These characters are distributed as follows :—

- (1) Eye-spots present in *P. socialis*, *P. major*, *P. elioti*, *P. gardineri*, *P. pictus*; absent in *P. claparedi*, *P. aciculigerus*, *P. gracilis*.
- (2) A single strong seta in 4th notopodium in *P. socialis*¹, *P. major*, *P. claparedi*, *P. pictus*. More than one seta strengthened. *P. gracilis* with three, *P. gardineri* three, *P. elioti* two, and *P. aciculigerus* eight.

¹ In *P. socialis* two setæ may exceptionally occur, but the extra one is always smaller than the one it accompanies.

- (3) The parapodia of the region C consist of double neuropodial tori and a clavate papilliform notopodium containing a single seta in all the species except *P. aciculigerus* and *P. claparedi*.
- (4)¹ Tubes straight, occurring singly in *P. claparedi*, *P. elioti*, *P. major*. Twisted together, in numbers, *P. socialis* and *P. pictus*.

PHYLLOCHÆTOPTERUS ELIOTI², sp. n. (Plate XVI. figs. 1-3 & 8; Plate XVII. figs. 10-13.)

Of this species numerous specimens occur in Chuaka Bay, Zanzibar. The straight, stiff, opaque black tube, 6 to 9 inches long, is buried in the sand at low tide, one or two inches only projecting. Its presence is usually rendered conspicuous by the growth of a tuft of bright green enteromorpha on the projecting portion.

The colour of the living animal is milk-white anteriorly, and black posteriorly. There is no pigmentation, and the brilliant blue and yellow colours described by Claparède and Lo Bianco in the Naples species are not found in either of the two species I have seen alive. The black colour of the gut gives the usual green solution in alcohol.

The peristomium is very mobile, the whole shape of the head being thus very different in different specimens. When expanded, its shape is as in Pl. XVI. fig. 1. In a few cases only, where the head is much contracted and bent back, does the prostomium and its eye-spots come into view as in fig. 2.

The first pair of tentacles are very slender and long, attaining a length of 9 mm.

The fore-body measures, in a large specimen, 6 mm. in length by 2.5 mm. in breadth, and consists of about 14 setigerous segments. (There were 13 in three specimens, 14 in three more, and 15, 16, and 17 each in three more. The average is thus 14 in nine specimens.) The notopodia are very short and stumpy, but the setæ and their arrangement, as in the other species of the genus, recall *Chaetopterus*. The fourth foot has two strong setæ on each side, rarely three on one side or the other, though in one specimen there were three on one side and four on the other. The ordinary setæ are all straight.

The region B (fig. 3) consists of from 20 to 25 segments, the parapodia of which are very like those of *P. gardineri*, except that the notopodial flap is slightly smaller, and there is a long space between it and the ventral portion of the neuropodium, and the parts of this latter are of more nearly equal size. The neuropodium of the first segment of the gill-region is not divided. There are in each notopodium five long setæ whose flexible heads project. The uncini (fig. 8, c) are triangular with very fine teeth, just visible under a $\frac{1}{8}$ -inch objective.

The hind-body has more than 25 segments, but none of my

¹ The tubes of Gardiner's two species were unfortunately not obtained.

² Thus named in honour of Sir Charles Eliot, K.C.M.G., C.B., H.M. Consul-General at Zanzibar, and Commissioner for British East Africa.

specimens are quite complete. The notopodia are the usual clavate papillæ containing a single seta. The neuropodia are as in the gill-bearing region, but much smaller.

The two species *P. elioti* and *P. gardineri* are closely related, differing only in the reduction of the peristomial collar in the latter and the proportions of the mid-body parapodia and setæ.

The only work on the internal anatomy of a member of this genus is the section of the fore-body of *P. claparedi* given by McIntosh, although examination of the anatomy of the species of *Phyllochætopterus* would be extremely interesting, both for comparison among themselves and with the other genera of the family¹, especially *Chætopterus*. Having neither time nor full opportunity for this work, to which my inclinations are most strongly drawn, I can only give here a few deductions from the examination of a series of sections of a specimen of this genus, which appear to differ in many minor details from the above-mentioned section of *P. claparedi*.

Body-wall.—The region A is, as shown by the sections figured (Pl. XVII. figs. 11 & 12), an almost solid mass of glandular and muscular tissue, in marked contrast to the delicacy of the regions B and C. The whole of the ventral epithelium is strongly glandular beyond the limits of the well-marked ventral shield, and these glands extend anteriorly to the dorsal surface and even on to the prostomium. The cuticle is of extreme delicacy, if really present. The musculature consists of weak circular and very strong longitudinal muscles, but the division of the latter into two dorsal and two ventral bundles cannot be made out. In the regions B and C the only muscle occurring dorsally is a very delicate circular layer (Pl. XVII. fig. 13). Diagonal fibres can be traced in the region A between the nerve-cords and the notopodia, which become more definite muscles in the region B (fig. 13).

The *nervous system* is in contact with the skin. The two ventral cords lie at a distance from one another in the region A, but approach one another posteriorly (*cf.* figs. 12 & 13), their arrangement corresponding thus to that in *Chætopterus*. Transverse commissures, portions of one of which are shown in Pl. XVII. fig. 12, connect the two cords.

The brain (Pl. XVII. fig. 10), which in *Chætopterus* is a narrow band dorsal to the mouth, not differentiated from the circum-oesophageal commissures, is here more distinct, in correspondence with the presence of the prostomium in this genus and its absence in the case of *Chætopterus*. It is a perfectly simple swelling of the circum-oesophageal commissures. The continuity of the nervous system with the epidermis is shown by a comparison of the sections of the prostomium given in figs. 10 & 11. The former shows the circum-oesophageal connectives, that on the left as it crosses from the ventral to the dorsal side, that on the right, near the eye-spot (*e*) passing into the prostomium. The replacement of the ordinary glandular epithelium of this area by the densely

¹ For anatomy of *Telepsavus*, see pl. xiii. and its explanation in Claparède's 'Annélides Sédentaires.'

staining nerve-nuclei of the brain (which are similar to those seen on the outer side of the ventral nerve-cords &c.) is shown distinctly, this replacement being complete in fig. 10, where the epidermis is composed entirely of nerve-cells.

The eye-spots are a pair of groups of cells, each containing numerous minute granules of black-brown pigment. These are in continuity with the nerve-cells of the brain, but are anterior and dorsal to its fibrous part.

The *cœlom* is small and broken up into several distinct portions. The largest of these are a pair of spaces lying laterally and ventrally to the gut (fig. 12), bounded dorsally by the powerful muscles of the seta-sac. Dorsally and medianly, commencing as a space in the prostomium, is a third part which posteriorly becomes a mere canal surrounding the dorsal blood-vessel. In the region B the *cœlom* is more normal, though reduced in size. It remains divided into right and left halves by the dorsal and ventral mesenteries of the gut.

The *vascular system* consists of dorsal and ventral vessels, both running in the gut-mesenteries. The former breaks up at the base of the prostomium into three branches (fig. 10), and large connecting-vessels are found in the anterior segments. Posteriorly the dorsal vessel forms a large sinus covering the dorsal wall of the gut (fig. 13).

Alimentary canal.—The mouth is richly ciliated, and the outer ends of its columnar epithelial cells contain a few minute specks of the black-green pigment so characteristic of the family. These are absent from the narrow triangular gut of the region A, but reappear in great quantities in the larger thick-walled alimentary canal of the regions B and C (fig. 13).

The gut-lining here consists of long crowded cells, the swollen distal ends of which are crowded with minute specks of the pigment, indicated by dark dots in the figures.

The transverse sections of the notopodial gills, shown in fig. 13, are interesting. The space which they contain is *cœlomic*, and at its centre is a bundle of five or six setæ wrapped closely together by fleshy tissue. The transverse section of this resembles that of a telegraph-cable, the wires being represented by the setæ. At each end of the oval section is seen a sharply-cut groove, the sides of which are of granular, rather deeply-staining protoplasm, without nuclei, supporting externally very long cilia. Laterally is a more deeply-stained area of the epithelium, perhaps of nervous function.

PHYLLOCHÆTOPTERUS PICTUS, sp. n. (Plate XVI. fig. 5.)

The tubes of this species are brown and translucent, quite free from sand or mud. They were found clustered together in considerable numbers on the under side of a large stone at low-water level on Pungutiayu islet, Wasin. Each tube has two openings, each limb of the U being about 4.5 cm. long. The bending is irregular, and they are twisted and fused together, so that it is usually almost impossible to separate out any one tube.

The contained worms are the smallest of the species described here, or in (6), being slightly smaller every way than in *P. dioti*.

The specific name refers to the abundance of brown colour found on their tentacles and fore-body. Pigmentation, except of the gut, is rare in the Chaetopteridae. Of the other species, it is described in only two, viz. *P. claparedi* (3) and *P. socialis* (1): in both these it is comparatively slightly developed.

The ground-colour of the anterior region, tentacles, and parapodia of *P. pictus* is, in life, creamy white. The greater part of the posterior regions is, as usual, black, by reason of the pigmentation of the gut.

On either side of the groove which runs along the upper surface of the larger tentacles are regularly arranged squarish blotches of brown, as shown in Pl. XVI. fig. 5. Brown dots are scattered also over the pro- and peristomium and the anterior segments of the fore-body. There are two dark bands with indefinite edges along the ventral bases of the notopodia, and a broad crescent across the ventral surface of the end of the region A.

The mouth is not at all funnel-shaped, but rather slit-like, the two small peristomial lappets coming together from either side. The prostomium is large, flattened from side to side, and projects above the dorsal surface of the fore-body. The very slender second setigerous pair of tentacles lie close on either side of it, being thus very inconspicuous. Two elongated, but distinct, eye-spots, of a dark brown colour, occur one on each side of the prostomium.

The regions A and B consist of the following numbers of segments in different individuals:—

A ...	15	16	*	13	15	*12	15	*13
B ...	7	9	5	7	5	3	8	—

* These specimens were below the average size.

The fourth notopodium has but one large seta of the shape shown in Pl. XVI. fig. 9, *a*. The bending of this seta is remarkable as occurring only in this species. Its three teeth, when seen from one point of view, give an explanation of Langerhans's figure of the corresponding seta in *P. gracilis*, which is not otherwise intelligible.

The other setæ are all straight, and present no peculiarities except those of the last notopodium, which are bent, and the head is finely toothed (fig. 9, *c*).

The parapodia of the region B (figs. 5 & 6) are small, the neuropodial ridges especially so. In correspondence with this the uncini are very minute and delicate (·03 mm. long), and their teeth barely visible under a $\frac{1}{6}$ -inch objective (fig. 9, *d*). The neuropodia do not extend far up the side of the body, and the space between them and the notopodial gills is not filled up by the triangular membranous gill-flap as in the other species (fig. 6). The notopodia contain two or three thin setæ which do not project.

In the region C the notopodia are reduced to little clavate papillæ, containing one seta, as in all the other species except

P. claparedi and *P. aciculigerus* (see fig. 6, of *P. elioti*). The neuropodia also are small.

List of the Literature.

- (1) CLAPARÈDE.—Annélides du Golfe de Naples, 1868.
- (2) LANGERHANS.—“Ueber einige Canarischen Anneliden.” Nov. Act. der Leop.-Carol. Deutschen Akad. Bd. xliii., 1881.
- (3) MCINTOSH.—‘Challenger’ Reports, vol. xii., 1885, p. 374.
- (4) ROULE.—“Campagne du Caudan.” Ann. d. l’Université de Lyon, 1896.
- (5) LO BIANCO.—Ann. Tub. nel Golfo di Napoli, 1893.
- (6) CROSSLAND.—J. Stanley Gardiner’s ‘Fauna and Geography of the Maldive Archipelago.’ In the press.

EXPLANATION OF THE PLATES.

PLATE XVI.

- Fig. 1. Normal condition of the head of *Phyllochætopterus elioti* (p. 172), as seen from dorsal side. $\times 10$.
2. Side view of a specimen whose prostomium and eye-spots are visible. $\times 10$.
 3. Side view of three segments of the region B. $\times 10$.
 4. Ventral view of the same.
 5. *P. pictus* (p. 174). Dorsal view of anterior part of body. $\times 10$.
 6. Side view of three segments of the region B. $\times 10$.
 7. A notopodium of the region C in either species. $\times 100$.
 8. Setae of *P. elioti* (p. 172).
 - (a) Thickened seta of fourth parapodium. $\times 83$.
 - (b) Normal seta from third foot. $\times 90$.
 - (c) An uncinus. $\times 1000$.
 9. Setae of *P. pictus* (p. 172).
 - (a) Thickened seta from the fourth foot. $\times 100$.
 - (b) Head of a normal seta from the same bunch. $\times 200$.
 - (c) From last foot of region A. The shaft is bent and part of the head finely toothed. $\times 100$.
 - (d) One of the uncini. $\times 1000$.

PLATE XVII.

- Fig. 10. Section of *Phyllochætopterus elioti* (p. 172) through the brain, bases of short tentacles, &c.
11. Section a little anterior to fig. 10, through mouth, first feet, &c.
 12. Section at level of fifth foot.
 13. Section near beginning of region B. All sections $\times 42$.

The meaning of the lettering on the figures of the Plates is as follows:—

<i>b.v.</i> = blood-vessel.	<i>n.</i> = nerve.
<i>circ.m.</i> = circular muscle.	<i>n.c.</i> = nerve-cells.
<i>cæ.</i> = cælum.	<i>n.cd.</i> = nerve-cord.
<i>d.bv.</i> = dorsal blood-vessel.	<i>nf.</i> = nerve-fibres.
<i>d.cil.</i> = dorsal ciliated groove.	<i>neph.</i> = nephridium.
<i>d.cæ.</i> = dorsal division of cælom.	<i>neur.</i> = neuropodium or ventral division
<i>d.neur.</i> = dorsal division of the neuro-	of the foot.
podia.	<i>noto.</i> = notopodium or dorsal division
<i>e.</i> = eye.	of the foot.
<i>g.</i> = gut.	<i>peri.</i> = peristomium.
<i>gill.</i> = gill-flap between noto- and	<i>ppd.</i> = parapodium or foot.
neuropodia.	<i>pro.</i> = prostomium.
<i>gl.</i> = glandular areas or epithelia	<i>s.</i> = seta.
&c.	<i>t₁</i> & <i>t₂</i> = first and second pairs of ten-
<i>lm.</i> = longitudinal muscle-layer.	tacles.
<i>m.</i> = muscle.	<i>v.bv.</i> = ventral blood-vessel.
<i>mo.</i> = mouth.	<i>v.neur.</i> = ventral division of the neuro-
<i>m. of ppd.</i> = muscles of parapodium.	podia.